

A FREQUENCY TRIPLED COUPLED OSCILLATOR ARRAY

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It has been proposed and demonstrated that an array of electronic oscillators coupled to nearest neighbors can be made to mutually injection lock and oscillate as an ensemble. It has been further shown that such a locked array can provide suitable excitation for the elements of a phased array antenna and that beam steering may be effected by tuning only the perimeter oscillators. [R. A. York, *IEEE Trans.*, MTT-41, pp.1799-1809,, Oct. 1993] [P. Liao and R. A. York, *IEEE Trans.*, MTT-41, pp. 1810-1815, Oct. 1993] [R. Ispir, S. Nogi, M. Sanagi, and K. Fukui, *IECE Trans. Electron.*, E80-C, 1211-1220, Sept. 1997] However, the adjacent oscillators can be no more than ninety degrees apart in phase and still maintain lock. Thus, for half wavelength radiating element spacing, the scan is limited to thirty degrees from normal to the aperture. One means of extending the scan range is to multiply the frequency of the oscillator outputs thus similarly multiplying their phases. [R. A. York and T. Itoh, *IEEE Trans.*, MTT-46, pp. 1920-1929, Nov. 1998] Such a system employing frequency doubling from 12 GHz to 24 GHz was recently reported. [J. Shen and L. W. Pearson, *Nat. Radio Sci. Mtg*, Boston, MA, July 2001] Although for a half wavelength element spacing, frequency doubling is theoretically sufficient to extend the scan to endfire, in practice this is not the case and at least frequency tripling will be required to achieve full scan capability. Thus, in this paper we report on the application of frequency tripling to the S-band array previously reported. [R. J. Pogorzelski, *Microwave and Guided Wave Letters*, 10, pp. 478-480.] The result is an agile beam X-band transmitter with scan range corresponding to triple the interoscillator phase difference.

The oscillators in the array are Pacific Monolithics PM2503 MMICs with external varactors for tuning and buffer amplifiers which effectively isolate the output from the coupling network. The frequency triplers are Miteq MAX3M072077 separately packaged with SMA connectors. The phase distribution over the array is measured at S-band via a nine element parallel phase measurement system using mixers and ninety degree hybrids and implemented in Labview™. This system provides a graphical display of the phase distribution from which the aperture phase can be inferred.